DIFFERENT PATTERNS OF STRUCTURAL AND MICROSTRUCTURAL DAMAGE IN NEUROMYELITIS OPTICA SPECTRUM DISORDERS

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INTRODUCTION and PURPOSE

The detection of structural and microstructural brain tissue abnormalities in neuromyelitis optica spectrum disorders (NMOSD) could provide useful insights to better understand disease pathology in-vivo.

We compared volumetric and Diffusion Tensor Imaging (DTI) abnormalities between NMOSD (2015 criteria), isolated recurrent optic neuritis (ON) and recurrent myelitis patients.

METHODS

Using a 3-Tesla scanner, volumetric and DTI brain MRI data were acquired from 20 NMOSD, 10 ON, 12 myelitis patients and 30 healthy controls (HC). Between-group comparisons of regional GM, WM volumes and DTI measures were performed using SPM12 voxel-based morphometry (VBM) and FSL Tract Based Spatial Statistics (TBSS). Correlations between MRI metrics and motor performance were also assessed.

Table 1. Main demographic and clinical measures from all subjects.

	NMOSD patients (N=20)	ON patients (N=10)	Myelitis patients (N=12)	Healthy controls (N=30)	p*
M/F	3/17	5/5	6/6	9/21	0.4
Age (SD) [y]	42.4 (11.9)	38.5 (13.1)	44.9 (13.3)	42.3 (11.1)	0.7
Median EDSS (range)	4.0 (1-7.5)	1.5 (0-4.0)	2.5 (1.0-7.0)	-	0.01
Mean disease duration (SD) [y]	7.2 (7.0)	8.4 (5.6)	4.4 (3.7)	-	0.2

Abbreviations: NMOSD=neuromyelitis optica spectrum disorders; ON=optic neuritis; SD=Standard Deviation; EDSS=Expanded Disability Status Scale. *Kruskall Wallis test.

RESULTS

Compared with HC, NMOSD patients showed atrophy of the thalami, right cuneus and floor of the fourth ventricle (Figure 1); ON patients showed atrophy of the optic tracts, cerebellum and left calcarine cortex (Figure 2).

Figure 1. Regional atrophy in NMOSD patients compared to HC in bilateral thalami (a); right cuneus (b) and floor of the fourth ventricle (c).

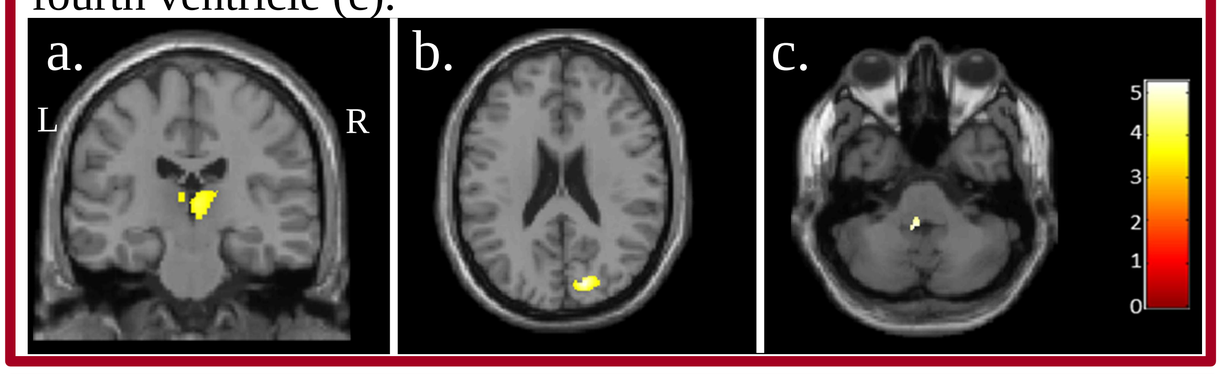
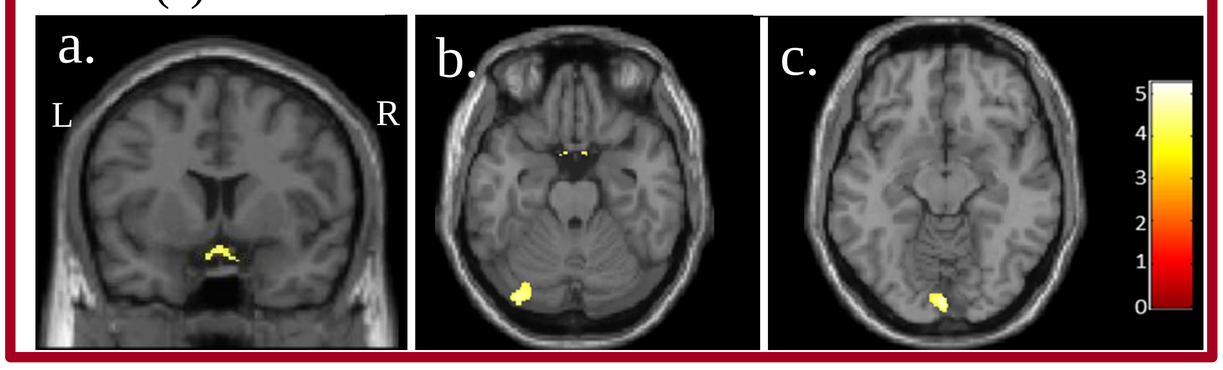


Figure 2. Regional atrophy in ON patients compared to HC in the optic tracts (a), left cerebellum (b) and left calcarine cortex (c).



Myelitis patients, compared to HC, showed atrophy of the bilateral thalami, right somatomotor cortex and supplementary motor area (Figure 3). Moreover, we observed in NMOSD patients atrophy in the middle occipital gyrus compared to both ON and myelitis patients (Figure 4).

Figure 3. Regional atrophy in myelitis patients compared to HC in the bilateral thalami (a), right somatomotor cortex (b) and supplementary motor area (c).

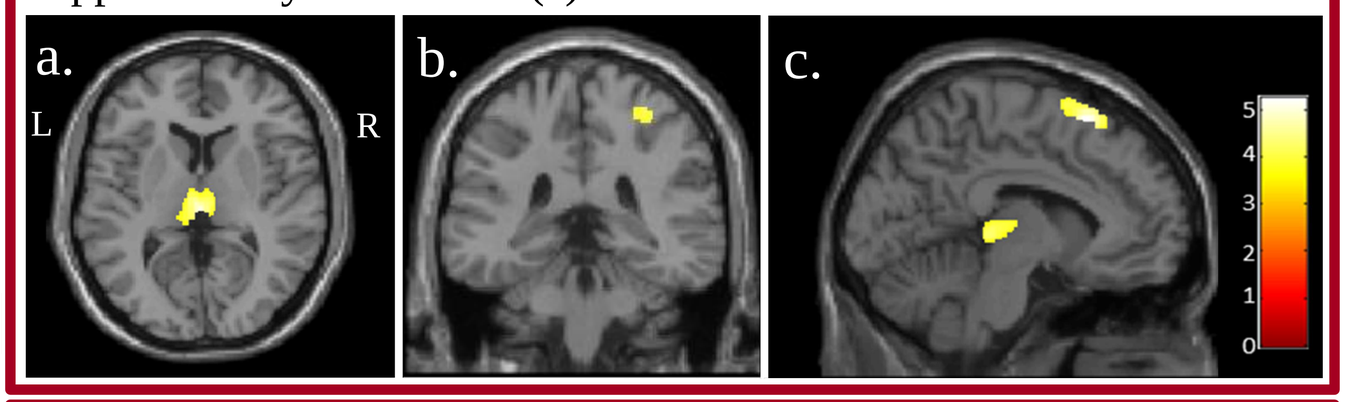
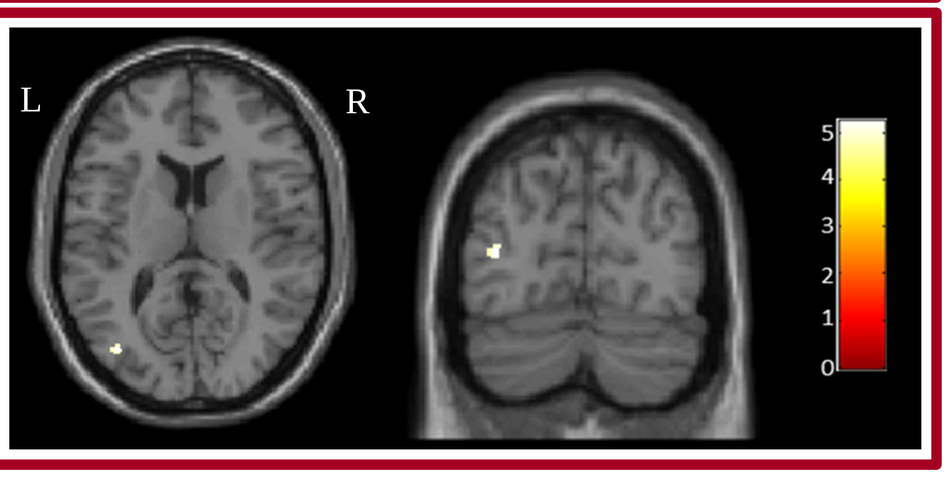


Figure 4. Atrophy in NMOSD patients compared to both, ON and myelitis patients in the left occipital gyrus.



TBSS analysis showed, in NMO patients compared to HC, a significantly lower Fractional Anisotropy (FA) in the optic radiations bilaterally (Figure 5) and a diffuse reduction of Axial Diffusivity (AD) in all WM skeleton (Figure 6). No correlations were observed with motor performance.

Figure 5. Optic radiations' (OR) regions of interest superimposed on the whole group fractional anisotropy (FA) skeleton (a). Histograms of the FA values from OR of HC and NMO patients (b).

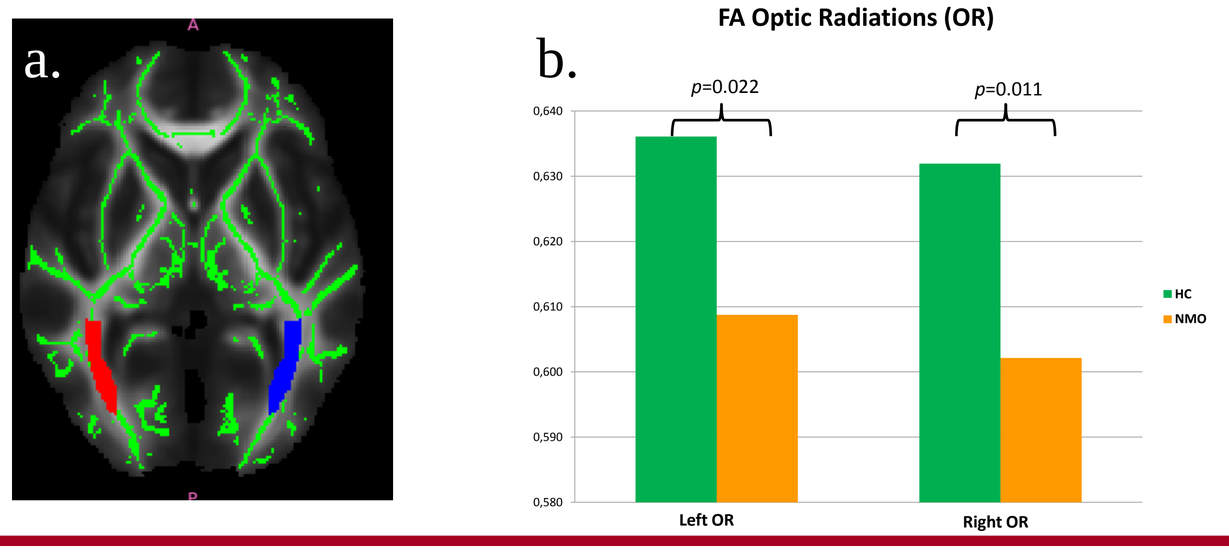
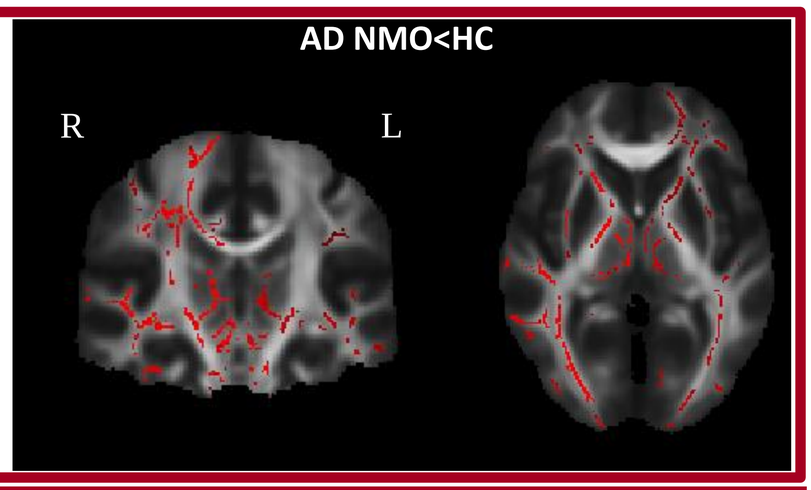


Figure 6. Diffuse Axial Diffusivity reduction in all WM skeleton of NMO patients compared to HC.



CONCLUSIONS

In recurrent ON and myelitis, structural abnormalities were observed in regions related to the clinical manifestations of such pathologies: visual areas in ON, thalamus and SMA in myelitis patients. NMOSD, compared to HC, showed atrophy and microstructural abnormalities in brain regions related to clinical manifestations (optic radiations and visual cortex, even more pronounced than in ON), but also in regions consistent with the higher expression of Aquaporin-4 antibodies (thalami and fourth ventricle). The selective reduction of AD observed in all WM skeleton of our NMOSD cohort might be an intriguing hallmark of diffuse microstructural damage in these patients.